DOCUMENT RESUME

ED 134 462 SE 021 940

TITLE	Science Curriculum Guide, Level 3.
INSTITUTION	Newark School District, Del.
PUB DATE	Sep 75
NOTE	202p.; For related documents, see SE 021 939-941; Contains marginal legibility in Appendices; Bibliography removed due to marginal legibility
EDRS PRICE	MF-$0.83 HC-$11.37 Plus Postage.
DESCRIPTORS	*Curriculum Guides; Educational Objectives; Elementary School Science; Elementary Secondary Education; Enrichment Activities; General Science; Junior High Schools; *Science Activities; *Science Curriculum; Science Education; Scientific Concepts; *Secondary School Science

ABSTRACT

The third of four levels in a K-12 science curriculum is outlined. In Level 3 (grades 6-8), science areas include life science, earth science, and physical science (physics and chemistry). Conveniently listed are page locations for educational and instructional objectives, cross-referenced to science area (i.e., life science, animals, genetics) and coded for concept. Six major themes provide the basis for study in all levels (K-12). These are: Change, Continuity, Diversity, Interaction, Limitation, and Organization. In Level 3, all six themes are grouped within a science area. Coded objectives are included for each theme. Activities emphasizing science processes are suggested for each objective. (CS)

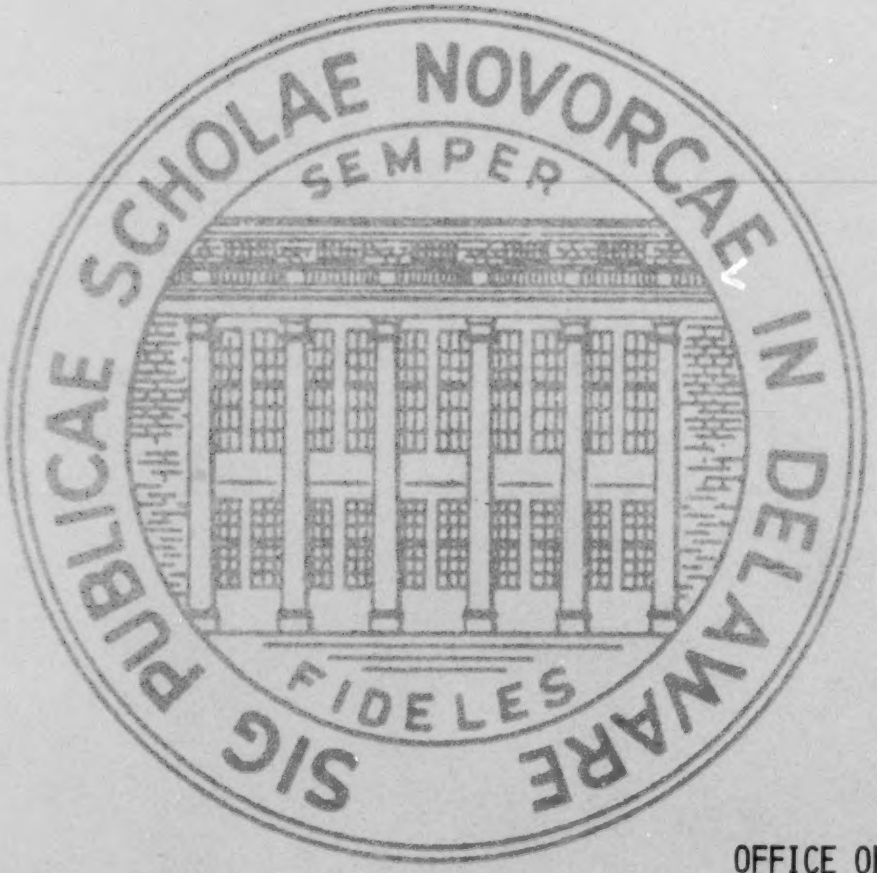
****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED134462

U S DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

SCIENCE CURRICULUM GUIDE
LEVEL 3



OFFICE OF INSTRUCTIONAL SERVICES
NEWARK SCHOOL DISTRICT
NEWARK, DELAWARE 19711

DATE: September, 1975

SE 021 940

SCIENCE CURRICULUM GUIDE

SEPTEMBER, 1975

NEWARK SCHOOL DISTRICT

NEWARK, DELAWARE

Dr. George V. Kirk, Superintendent
Dr. John E. Allen, Deputy Superintendent
Dr. Keith E. Stapley, Assistant Superintendent

BOARD OF EDUCATION
NEWARK SCHOOL DISTRICT

Mrs. Priscilla W. Crowder, President
Mr. William H. Clark, Vice-President
Mr. Randolph Lindell III
Mr. Richard B. Nelson
Mrs. Dorothy H. Ross
Dr. George V. Kirk, Secretary

TABLE OF CONTENTS

FOREWORD	iii
INTRODUCTION	iv
LOCATION OF OBJECTIVES	vii
TOPIC INDEX	viii
LEVEL THREE (6 - 8) - EARTH SCIENCE	
Change	2
Continuity	7
Diversity	11
Interaction	17
Limitation	20
Organization	23
LEVEL THREE (6 - 8) - LIFE SCIENCE	
Change	27
Continuity	31
Diversity	34
Interaction	41
Limitation	47
Organization	52
LEVEL THREE (6 - 8) - PHYSICAL SCIENCE	
Change	58
Continuity	63
Diversity	70
Interaction	77
Limitation	82
Organization	85
APPENDICES	
Appendix I	89
Appendix II	90
Appendix III	92
Appendix IV	93
Appendix V	94
BIBLIOGRAPHY	99

FOREWORD

This Science Curriculum Guide is intended to be just that - a guide. While it does not attempt to mandate the entire science program, K-12, it does furnish an overall context for curriculum and instruction. In whatever way science programs are developed in the various schools, the curriculum and instruction should be consistent with two sets of standards: (1) the six curricular and instructional goals* set forth in the 1974 report of the Program Advance Committee and (2) the goals and objectives in this curriculum guide.

This guide should be used as a tool to assist you to develop your curriculum and instruction. By using it as a tool you will increase both your effectiveness and your efficiency.

Loren J. Thompson
Director of Instruction

*The following goals for the foundation of Newark's educational program were accepted by the Board of Education:

Newark's educational program should prepare people who:

- think analytically/critically
- think creatively
- think and act humanistically
- possess basic skills
- can enter the job market and/or further education
- believe in and practice good citizenship

INTRODUCTION

This Science Curriculum Guide has been developed to provide direction to teachers of science in the Newark School District. It fits closely to the goals established by the Science Task Force of the state of Delaware and is patterned in part after the Equinox, a guide prepared by the Department of Public Instruction.

In order to provide flexibility the guide has been organized in four levels: Level One, K-2; Level Two, 3-5; Level Three, 6-8; and Level Four, 9-12. This makes it adaptable to the non-graded school and at the same time permits teachers in the graded system to select goals and objectives suitable to their students' needs.

Six major concepts in science provide the goals for this guide: Change (Ch), Continuity (Co), Diversity (D), Interaction (I), Limitation (L), and Organization (Or). These have been taken from Concepts in Science, developed by Dr. Kenneth Dowling of the State Department of Public Instruction, Madison, Wisconsin. These concepts have been sequenced alphabetically rather than in a logical order of occurrence. Education and instructional objectives have been grouped under these concepts with the understanding that there are areas of overlap.

In addition to the coding of the concepts a decimal outline system has been used with the number to the left of the decimal representing the level. To the right of the decimal two significant places have been used. The tenths place is assigned to the educational objective(s); and the hundredth, the instructional objective(s).

Ex:

Ch 2.30 Change Level Two, third educational objective

D 1.24 Diversity Level One, second educational objective, fourth instructional objective.

Activities suggested for accomplishing the objectives emphasize the processes of science as set forth in Science, A Process Approach. These include: experimenting, observing, communicating, classifying, measuring, predicting, interpreting data, inferring, formulating questions and hypotheses, making operational definitions, and formulating models.

Examples of possible resources have been included under Notes in this guide. For activities in computer simulation one should refer to Appendix B in the district's Computer Curriculum Guide.

A wide variety of suitable community resources: i.e. discussion leaders for the classroom, or tours of facilities, have been cataloged by the Educational

Resources Association (ERA). Teachers need only to contact the ERA office in the administration building to obtain information regarding the desired resource.

In the Notes column of the guide a number of careers have been listed which relate in part to the educational objectives assigned to the concepts. In using the guide teachers may wish to make students aware of these and other careers for which a science background is needed.

Credit for the production of this curriculum guide goes to several classroom teachers as well as to other interested educators. Staff members who assisted in its preparation, either through writing or by leading or participating in workshops include:

Donald Allen
Sharon Allen
Janet Baldwin
Frank Bensinger
Clifford Brown
Roy Brubaker
Jeffrey Byrem
Paula Daitzman
Len Ference
Ralph Graham
Bernadette Grauer
Patricia Guthrie
Susan Hartzler
Janice Hess
Roberta Hopkins
Ray Kenzierski
Faye Markowitz
Beatrice Mathewson
Bertha Morris
Richard Petrosky
Robert Reeder
Sandra Richardson
John Rogge
Ora Ann Shultz
Edward Stowell, Jr.
Verne Wood

Consultants: Thomas Baker, Specialist Del Mod
Catharine Y. Bonney, Supervisor of Science
Jack Cassidy, Supervisor of Reading
Anthony Cottone, Career Guidance Specialist
John Reiher, State Supervisor of Science
Loren Thompson, Director of Instruction
Primo Toccafondi, Career Education Coordinator

Catharine Y. Bonney
Supervisor of Science

LOCATION OF OBJECTIVES

		Objective	Page
LIFE SCIENCE			
Animals	Genetics	Co 3.20	31
	Function	D 3.10	34
	Reproduction	D 3.30	38
	Cell Specialization	Or 3.50	55
Behavior	Plants	Co 3.30	33
	Effects of natural phenomena	D 3.10	34
	Effects of physical factors	I 3.10	41
	Interactions of organisms	I 3.20	42
Cell	Anatomy	Or 3.10	52
	Structure	Or 3.20	53
	Reproduction	Or 3.30	54
	Function - Specialization	Or 3.40	54
	Function	Or 3.50	55
Classification	Characteristics of organisms	Ch 3.40	30
	Structure	D 3.20	35
	Cell specialization	Or 3.40	54
Plants	Genetics	Co 3.20	31
	Function	D 3.10	34
	Reproduction	D 3.30	38
	Cell specialization	Or 3.50	55
Protists	Genetics	Co 3.20	31
	Function	D 3.10	34
	Reproduction	D 3.30	38
	Interdependence	Or 3.40	54
	Cell specialization	Or 3.50	55

TOPIC INDEX

EARTH SCIENCE

Landforms (mapping)	Ch 3.13	Ch 3.31	I 3.15	Or 3.12
	Ch 3.15	Co 3.21	L 3.21	Or 3.13
	Ch 3.21	Or 3.11		
Rocks and Minerals	Ch 3.14	D 3.11	I 3.12	L 3.31
	Ch 3.13	D 3.12	I 3.13	Or 3.16
	Co 3.14	I 3.11	I 3.14	
Weather	Ch 3.15	Ch 3.13	Co 3.17	I 3.16
	Ch 3.22	Co 3.15	D 3.14	
	Co 3.11	Co 3.16		
Fossils & Prehistoric Life	D 3.13			
Universe	Ch 3.11	I 3.18	Or 3.15	
	Ch 3.12	D 3.15	L 3.11	
	Ch 3.31	L 3.41		
	Ch 3.11	I 3.17	Or 3.14	
Oceanography	Ch 3.31			
	D 3.14			
	L 3.21			
History of Science	D 3.21			

PHYSICAL SCIENCE

Physics

Light & Color	Co 3.32	I 3.14	Or 3.22	
	Ch 3.21	I 3.15	Or 3.23	
	Ch 3.22	I 3.16	Or 3.24	
	D 3.33	Or 3.21		
Heat & Temperature	Co 3.11	D 3.23	Co 3.40	
	Co.3.42	L 3.12	L 3.13	
	Co 3.43			

Sound and Music	I 3.12			
Matter	Co 3.20	Co 3.21	Co 3.34	Co 3.41
	Ch 3.30	D 3.24	I 3.10	L 3.10
	L 3.12	Or 3.20		
Electricity and Magnetism	Co 3.12	Co 3.31	L 3.14	
History of Physics	D 3.41	D 3.42	D 3.40	
Energy and Simple Machines	Co 3.12	Co 3.20	Co 3.33	Ch 3.31
	Ch 3.32	D 3.24	D 3.30	D 3.31
	D 3.32	I 3.20	I 3.21	I 3.31
Measurement	D 3.34	Or 3.13		
Motion & Forces	Co 3.10	Co 3.11	Co 3.13	Co 3.14
	Co 3.20	Co 3.21	Co 3.33	I 3.13
	I 3.30	L 3.11		
Chemistry				
Atoms and Their Structure	Co 3.50	D 3.21	D 3.22	D 3.25
	Or 3.12			
Physical and Chemical Change	Ch 3.33	Ch 3.40	Ch 3.41	Ch 3.50
	Ch 3.51	Co 3.50	Co 3.51	
Element, Compound, and Mixture	Co 3.50	D 3.21	D 3.25	Or 3.12
Types of Reactions and Bonding	Ch 3.10	Ch 3.11	Ch 3.12	Ch 3.13
	Ch 3.31	Ch 3.32	Ch 3.50	Ch 3.51
	Co 3.51	Co 3.51	D 3.10	D 3.11
	D 3.12	D 3.25		

Properties of Matter	Ch	3.33	Co	3.40	Co	3.41	D	3.24
	D	3.26	L	3.12	L	3.13		
Measurement	D	3.34	Or	3.13				
History of Chemistry	D	3.40	D	3.41	D	3.42		

x

SCIENCE CURRICULUM GUIDE

LEVEL 3 (6 - 8)

EARTH SCIENCE

CHANGE

Level Three (6-8), Earth Science
Our environment, living and non-living, microscopic, and macroscopic, is constantly undergoing change.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch 3.10 Nature is constantly influencing changes in our environment.		Careers: Astronomer Cosmologist Geologist* Glaciologist Historical geologist Hydrologist Minerologist Petrologist Seismologist Teacher Vulcanologist
Ch 3.11 Give a plausible explanation for the origin of the solar system.	. Write a short story and make a model to show how our solar system came into being. . Research in various scientific journals and texts, possible explanations of the origin of our solar system. . Construct a geologic time line showing geologic occurences in the past five billion years.	*Contact the state Geological Survey or the state university for a speaker.
Ch 3.12 Demonstrate how weight of an object is affected by gravitational force of different planets.	. Make a graph showing the weight of a fifty kilogram man on various planets.	
Ch 3.13 List several ways in which nature changes the surface of the earth.	. Make a chart comparing the Mercalli and Richter scales. . Make a model or sketch of a seismograph. (Lab on file.)	

Objectives	Suggested Activities	Notes
	. Place on a map of the world the locations of earthquakes and volcanoes that have occurred during the last 100 years. Relate to locations of Delaware earthquakes.	
	. Make graphs showing the names of cities involved and the cost in lives or money for the earthquakes and volcanoes mentioned in previous activity.	
	. Report on recent volcanic activities.	Movie: "Birth of a Volcano"(DPI)
Ch 3.14 Describe how older minerals can be changed into new minerals.	. Research how gases, liquids, pressure and heat change surrounding minerals to a new type. Ex., dolemite, diopside and/or actinolite.	
	. Research as to how the following minerals are formed: pyrrhotite, wolframite, zircon, sphalenite, stibnite.	
	. Research and explain how the action of air and water on minerals at or near the surface of the earth produces new minerals. Ex., azurite, bauxite, pyrolusite.	
	. Research and explain how ground water and streams carry dissolved and suspended material to the sea where new minerals are formed by precipitation of dissolved material. Ex., calcite, halite, quartz, siderite.	

Objectives	Suggested Activities	Notes
Ch 3.15 Describe how the earth's crust undergoes changes as a result of wind, running water, glaciers, tides, ground water, weathering, and pressure.	. Sketch or diagram the earth's rock cycle: formation of granite, gabbro, basalt shale, sandstone, limestone schist, slate, marble, serpentine	
	. Sketch and explain the water cycle.	
	. Use a "square box" to show how anticlines and synclines are made. (Lab on file.)	Earth Science, McGraw-Hill, 1973, p. 135.
	. Make an artificial stream observing result on sediments. (Lab on file.)	Earth Science, McGraw-Hill, 1973, p. 135.
	. Sketch a map of the United States showing where various glaciers stopped.	
	. Research the origin of Lake Agassiz, Mississippi River.	
	. Over a period of several days bake and freeze a block of shale. Record and explain your observations.	
Ch 3.20 Man is constantly influencing changes in his environment.	. Drink of the Nile (Lab on file).	Careers: Air pollution control aide Air pollution control technician Air quality controller City planner Conservation officer
Ch 3.21 Identify misuses of land areas within the school district and suggest possible corrective steps.	. Take pictures of areas around your neighborhood which are littered and polluted. Prepare a bulletin board display.	

Objectives	Suggested Activities	Notes
	. Report on how solid wastes are displaced in your area. . Report on method used by your city for disposing liquid waste. (Lab on file.) . Note locations of various abandoned lots and buildings. Write letters to Representatives, State Senators and County Zoning Commission. . Find areas which are run down. Form a group to clean up and make area useful once again. . Water: the common waste recipient (lab on file).	Ecological technician Ecologist Environmentalist Fish and wildlife service Planning aide Pollution recycling technician Sanitation engineer Sanitarian* Teacher *Visit the county sewage treatment plant.
Ch 3.22 Describe how air pollution affects our atmosphere.	. Report on theories which suggest how air pollution may affect our climate. . Devise a single experiment to find what materials are in the air. Assume that there is a control. . Obtain data showing figures of reduced air pollution in your area. Graph the findings. . Air and life. (Lab on file.)	Movie: "The Air We Breathe" (Shell Oil)
Ch 3.30 Energy can be changed from one form to another.		Careers: Geologist Geophysicist Hydrologist Meteorology Oceanography Physicist

Objectives	Suggested Activities	Notes
Ch 3.31 Design an experiment illustrating how energy is transformed from one form to another.	. Use a solar cell to make a radio flashlight bulb work. . Place a number of plants, twigs and leaves in a jar with a one-hole stopper. Insert a glass tube in hole. Make sure there is a good seal. Heat the jar. After a few minutes, heat the gas that comes from the tube. . Research how tides are used to generate energy. (Lab on file.) . Sketch a model of the sun and moon and explain how the changing position of the bodies cause tides. . Research as to how geysers are being used to provide energy for some parts of the country. . Report on how geo-thermal energy can solve our energy problems. . Make a model showing how running water can be used to produce electrical energy.	

CONTINUITY

Level Three (6-8), Earth Science
There is constancy in cause-and-effect relationships which precludes any abrupt reversal in natural phenomena.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Co 3.10 Nature has given us reliable, constant and predictable phenomena on which to observe, form hypotheses and base conclusions.		Careers: Astronomer Biologist Climatologist Conservationist Geologist Hydrologist Meteorologist
Co 3.11 Demonstrate the ability to record information by constructing a graph using data containing two variables.	. Graph the relationship between radius and circumference of each planet. . Graph the relationship between planet rotation time and revolution time. . Graph the relationship between gravitational force of a planet and weight of an object. . Make a graph comparing average temperature and rainfall of cities with the same latitude. . Make a graph comparing average temperature and rainfall of cities with the same altitude.	
Co 3.12 Describe evidence of past continental glaciation.	. Research present day glaciers. . Compare pictures of V shaped valleys to those of U shaped.	

Objectives	Suggested Activities	Notes
	. Examine and research the geological history of the Great Lakes.	
	. Sketch moraines which have been identified and attributed to glaciers of the United States.	
	. Get 3 ice cubes of equal size, cover each top with a sheet of asbestos. Leave one as a control. Add a weight of 500 grams to one and a weight of one thousand grams to the other. Observe which one melts faster.	
Co 3.13 Distinguish how man is directly and indirectly dependent upon soil.	. Research on how, without soil, food and biological cycles would not exist.	
	. Sketch a vertical cut of land from soil down to bedrock. List the uses of each layer.	
	. Show which type of soil absorbs more water. (Lab on file.)	Pathways in Science, Earth Science, p. 110
	. Research data and graph results showing makeup of soil.	
	. Make a chart showing the relationships between climate and soil content.	
	. Soil pollution (lab on file).	
Co 3.14 Demonstrate the method of determining the specific gravity of rocks and minerals.	. Weigh a mineral specimen. Record the volume of water that is displaced by the specimen (using a graduated cylinder). Calculate the specific gravity of the mineral.	

Objectives	Suggested Activities	Notes
	. Find the specific gravity of: quartz, pyrite, galena, feldspar, etc. Compare your results to a chart of specific gravities. . Given various minerals and their specific gravities, determine their name. . Specific gravity of minerals (lab on file).	
Co 3.15 Demonstrate that the atmosphere is filled with gas.	. Draw a chart or a circle graph to show the composition of the atmosphere. . Make a chart which shows the layers and height of our atmosphere.	
Co 3.16 Demonstrate that the atmosphere exerts pressure.	. Obtain a can (a ditto master fluid can will do). Boil a small amount of water in the can. Recap and allow to cool. . Fill a glass with water. Put a piece of cardboard over it. Hold hand on cardboard. Turn glass upside down. Remove hand. (Lab on file.) . Demonstrate use of Madgeburg hemispheres. . Stretch a rubber sheet over a milk bottle fastening it with a rubber band. Glue one end of a wooden splint to the sheet. The other end should point to a chart with about 1 mm interval between 76.5 cm, 76. cm, 75.5, 75, etc. Compare chart with your newspaper readings.	

Objectives	Suggested Activities	Notes
	. Fill a small pail with water. Using a 1/4" - 1/2" diameter hose, siphon the water to a larger pail.	
	. Construct a generalized map or model showing the wind belts of the earth.	
	. Air has pressure (lab on file).	
	. Construct simple weather instruments.	
Co 3.17 Describe how man is directly and indirectly dependent upon the weather.	. Predict weather based on general weather phenomena.	
	. Demonstrate convection currents with a shoe box, candle and a smoking paper towel.	

DIVERSITY

Level Three (6-8), Earth Science
The vast number of natural phenomena which can be observed display a wide variety of similarities and differences.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
D 3.10 By classifying and identifying objects on the earth, we find many similarities among matter. It is only through careful observation and testing of hypotheses that we are able to differentiate. In differentiating between objects with apparent similar characteristics, physical as well as chemical properties of the objects must be used.		Careers: Astronomer Geologist Hydrologist Mining area restoration Petroleum geologist Technician
D 3.11 Construct a classification key to identify a small group of common minerals and rocks.	. Given a mineral or rock, classify it according to: hardness, luster, color, shape, specific gravity, streak, the action of HCl, and magnetism. (Lab on file.) . Develop a hardness scale from 1 to 10 using various known objects: dirt, chalk, etc. State the test as well as the example. (Lab on file.) Hardness — Test — Ex. 1 — Scratches easily when finger nail passes over it. — Talc	

11

Objectives	Suggested Activities	Notes
	. Place marble chips in HCl with stopper. Place tube through stopper, one end in jar of chips, the other in beaker of limewater. Observe. (Lab on file). . Research the names of various rocks and common minerals. Ex., platinum, pyrite. . Research the color of the following gems, stating which month has it for a birthstone: diamond, amethyst, topaz, emerald, sapphire, ruby, jade, lapis, opal. . Collect and identify some of the naturally occuring minerals and rocks in your locality.	
D 3.12 Identify common rocks: igneous, metamorphic, sedimentary.	. Make sedimentary rocks: (Lab on file). Mix soil, sand and pebbles with some water in a jar. Stir thoroughly. Allow material to settle. Get a small amount of cement. Pour it over the first batch. Let it harden. Add a second mixture of soil, sand and pebbles. After a few days, when all the water has evaporated, crack the jar carefully.	

Objectives	Suggested Activities	Notes
	. Using sketches, show how stalagtites and stalactites develop in caverns.	
	. Collect pictures of famous monuments and building. Label them according to the kind of stone used to build them.	Visit a local gravel pit or stone quarry.
	. Ask a stoneman's supply yard for some samples of various stones.	
	. Show how limestone served as a good building block by its use in the pyramids.	Study Indian artifacts to show the economic importance of stone to primitive peoples.
	. Start a rock collection. (Lab on file.)	
	. Make a chart listing various rocks and the chemical elements in them.	
	. Pan for "gold." Use a pie pan with sloping sides; sand (as light colored as possible); and pyrite or galena crushed into sand-size particles.	Challenges to Science, Earth Science.
	. Boil a small quantity of water. Stir in as much salt as the water will dissolve. Divide solution into two shallow glass dishes. Heat one dish gently over a flame until crystals of salt form. Other is a control.	Pathways in Science, Earth Science, p. 17.
D 3.13 Classify similarities and differences in fossil specimens.	. Make an artificial "fossil." Pour a thick plaster of paris paste in a small box. Gently press a leaf, twig or fruit pits in the plaster. Allow to dry and remove the implanted material.	

Objectives		Suggested Activities	Notes
		. Make a chart showing and sketching invertebrate animals which may be found from Paleozoic time to present: corals, bryozoa, brachiopods, echinoderms, trilobites, cephalopods, gastropods, pelecypods. Compare these sketches with fossils you may have.	Visit the C and D Canal, and the Army Corps of Engineers' Museum
		. If you have a number of rocks which contain fossils, calculate the age of the rocks by comparing them to fossils.	
		. Identify fossils (lab on file).	
D 3.14	List various forms of energy and give an example of each.	. Research on how the power of tides can be used to run generators and turbines.	
		. Using a solar cell, show how enough energy may be made from it to light a small flashlight, radio.	
		. Using "tinker toys," make a small windmill. Design your apparatus so that the windmill is attached to some device which works only by energy coming from windmill.	Scholastic Newstime, February 28, 1974.
D 3.15	Describe conditions necessary for eclipse of the sun and moon.	. Keep a record of sketches of the moon every day for an entire month. (Lab on file.)	
		. Keep records, then plot information on a graph showing the time of sunrise and sunset each day. Check with daily newspaper.	

Objectives	Suggested Activities	Notes
	. Remove the ocular (focusing) lens from a projector. Shine light on a white wall or screen about 8 feet away. Hang a basketball from a string in the path of the light. Repeat with other figures changing the distance of the object from the light. Observe. . Sketch or make a model of a) Lunar eclipse b) Solar eclipse (lab on file) . Using a mechanical planetarium, observe position of earth and sun and moon during Lunar Eclipse, Solar Eclipse. . Research solar and lunar eclipses and prepare a report on each. . Use an almanac or a good resource on astronomy, make a list of dates when a lunar eclipse is expected.	
D 3.20 · Through researching and experimenting, man has accumulated a wide variety of scientific knowledge.		
D 3.21 Identify the contributions of famous scientists.	. Investigate men of science associated with the Earth Sciences. Suggested names are: Tycho Brahe, Nicolaus Copernicus, Erastosthenes, Galileo, Johannes Kepler, Isaac Newton, Ptolemy, Jean Foucault, Neil Armstrong, Robert Goddard, Yuri Gagarin, Otto Von Guericke, Evangelista Torricelli, Robert Wegener, Werner Von Braun.	

Objectives	Suggested Activities	Notes
	. Investigate occupations in the area of the earth sciences. Examples: surveyor, astronaut, meteorologist radio and television, engineer, photographer, geologist, archaeologist, lab technician, navigator, petrologist, watchmaker.	Inquire at Getty Oil Refinery, Delaware City, for speakers.

INTERACTION

Level Three (6-8), Earth Science
The interactions of living and non-living matter in an environment and the resulting exchange of energy determine the nature of the environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
I 3.10 The composition and structure of the materials of the universe are determined by the conditions under which the material was formed and under which the materials exist. Composition and structure change as conditions change.		Careers: Astrochemistry Astronomy Astrophysics Climatology Cosmology Geology Glaciology Mathematics Meteorology Minerology Petrology Teacher Vulcanology
I 3.11 Hypothesize how minerals were formed.	. Compare the composition and formulation of quartz, galena, halite, feldspar, mica, gypsum and calcite.	
I 3.12 Describe how minerals can be changed from one class to another.	. Conduct experiments and make models to show how the following secondary minerals can be formed: dolomite, chalcopyrite, bauxite, malachite, and siderite.	
I 3.13 Explain how minerals form rocks.	. Conduct experiments to show crystallization, sedimentation, weathering, lithification, metamorphism, and melting.	

Objectives		Suggested Activities	Notes
		. Describe how the minerals are organized to form rhyolite, porphyry, granite, gabbro, pegmatite, conglomerate, sandstone, shale, coquina, shell limestone, coal, marble, quartzite, phyllite, slate, schist, and gneiss.	
I 3.14	Describe how one class of rocks can be changed to another.	. Make models and describe the formation of anthracite, coal, marble, hornblende, slate, schist, gneiss, quartzite and phyllite.	
I 3.15	List ways in which weathering, mass wasting, ground water, wind, waves, running water, glaciers, diastrophism, and vulcanism interact to produce the landscape of the United States.	. Make diagrams and models to explain the life cycles of mountains, plateaus, plains, lakes and shorelines. . Examine satellite photographs of the Delaware Bay Area.	Use ESCP stereoscopic map models Contact NOAA.
I 3.16	Design an experiment illustrating and explaining general and local atmospheric circulation.	. Construct a generalized map of the pressure and wind belts of the earth. Explain why the prevailing winds blow from their respective direction. . Make a model and explain India's monsoon winds. . Describe why sea and land breezes exist.	
I 3.17	Explain how the objects in the universe move together as a balanced mechanical system.	. Conduct experiments and make a model to explain the Doppler effect. . Describe the differences between the red and violet shift.	Visit district planetarium.

Objectives		Suggested Activities	Notes
		. Conduct experiments and explain parallax. . Make a sketch to explain planetary motion. . Discuss how cepheid variable stars can help an astronomer calculate the distance to a star. . Make models and diagrams to explain the origin of the universe and explain why it is felt that the universe is expanding. . Conduct an experiment to show the apparent movement of the heavens.	
I 3.18	Illustrate and explain how gravity and radiation pressure work together to cause nebular material to produce stars and star systems.	. Describe and make models to show the life history of a typical star. (Lab on file.) . Visit a planetarium and/or observatory. . Photograph trails of circumpolar stars. . Make a simple spectroscope. . Measure distance to sun/moon.	

LIMITATION

Level Three (6-8), Earth Science

Natural phenomena are limited by the fundamental nature of matter and energy. There is an overall tendency towards random distribution of energy and a corresponding tendency toward equilibrium in an environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
L 3.10 As man lives on the earth and explores the universe he becomes increasingly more aware of his limitations.		Careers: Astrobiologist Astrochemist Astronaut Astronautical engineer Astrophysicist
L 3.11 Identify the adaptations man must make when he leaves the earth and enters space.	. Write a short story using the title, "My Trip to Mars." . Report on weightlessness. . Research on how man found solutions for: getting a payload into orbit protecting capsule human needs of astronauts guiding capsule returning capsule to earth . Report on Van Allen's belt and how it affects man's space travel. . Research on the "escape velocity" of the earth. Moon. . Make a "Who's Who in the World of Astronauts." In this booklet show the life, background, schooling.	Coca-Cola game: Trip to Mars

Objectives	Suggested Activities	Notes
	. Make a chart of United States and Russian space adventures showing dates of accomplishments and highlights. Show how highlights correlate with each of man's problems which had to be overcome. . Stranded on the moon, students list 20 items necessary for survival. . Make a time line for space programs of the USSR and the U.S.	
L 3.20 The earth is limited in handling man's waste.		Careers: City Council member Climatologist Ecologist Meteorologist Regional planner Sanitation engineer
L 3.21 Demonstrate how the earth is limited in regarding ways to handle man's waste.	. Cut one 2.50 x 8.00 cm strip of newspaper, tissue paper, typing paper, etc. Label one end so that the different kinds of paper can be identified. Obtain 16 similar cans of garden soil. Place one piece of paper in each can covering it partially with soil. Water occasionally. Record data for 1, 2, 3, 4 weeks. . Make a display or sketch of "foreign material" man places in the air.	
L 3.30 The composition and characteristics of earth materials are determined by the composition of the original substances and conditions under which the new materials are formed.		Careers: Geologist Mine conservation technician Mineralogist Petrologist

Objectives	Suggested Activities	Notes
L 3.31 Describe how older rocks and minerals can be reorganized into new minerals and rocks.	. Make models to show how new minerals can be formed from older ones by weathering, sedimentary and metamorphic activity. . Report how increased heat and pressure will affect sandstone, limestone, shale, conglomerate, granite, gabbro, basalt, andesite and rhyolite.	
L 3.40 The revolutional period of a planet varies directly with its distance from the sun.		Careers: Astronomer Statistician
L 3.41 Describe the various facets of planetary motion.	. Design and conduct experiments which clearly demonstrate and explain Kepler's Three Laws of Planetary Motion. . List the period of revolution of the nine major planets.	

ORGANIZATION

Level Three (6-8), Earth Science
Systematic relationships exist in natural phenomena. Systems within systems comprise the universe.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Or 3.10 There exists a relationship between different geologic features of the earth which can predict and explain natural phenomena.		Careers Cartographer Historical geologist Oceanographer Surveyor Topographer
Or 3.11 Identify a current article from a popular periodic literature as to its probable scientific credibility.	. Read a "Breaking of Panzea." . Read magazine and newspaper articles. Categorize them as to the ones which are fact or fiction. Tell why, supporting your conclusions. . Cut out continents and try to create Panzea with the pieces.	Scientific American, October, 1970. Astronomer Cosmologist Minerologist Petrologist Physiographer Stratigrapher
Or 3.12 Demonstrate ability to use and interpret types of maps.	. Compare a topographic map with a geographic one. . Write the U. S. Geologic Survey Dept. of Interior, Washington, D.C. for a topographic map of your area as well as other parts of the country. Compare the areas. Also contact Delaware Geological Survey, Penny Hall, University of Delaware. . Collect maps showing landforms and water depths. Make a model or chart showing this information. . Using paper-mache, make a relief map of your locality.	

Objectives	Suggested Activities	Notes
	. Draw a "walking map" from your house to school. Make sure you have a scale and that directions are indicated. . Using a topographic map, point out hills and their elevation, length of rivers, scale contour intervals, slopes of hills. . Longitude and time (lab on file). . Topography (lab on file).	
Or 3.13 Identify the various "layers" of the earth.	. Make a model, cutaway view, of the earth showing inner and outer core, mantle and crust. . Make a model of earth with various types of colored clay in proportion to the earth's layer. Bore a medium diameter glass tube through your earth to show how readings of earth's interior are taken. Crust - 1 mm Mantle - 5 cm. Outercore - 4.5 cm. Innercore - 1.8 cm. . Research on what the construction of the earth's layers may infer as to its origin. . Construct a graph which shows the elements in the earth's crust.	
Or 3.14 Demonstrate the earth's rotation and revolution.	. In a gym attach a 7 kg. shot to a brass wire at least 4 meters long. Hook one end of the wire to ceiling. Pull shot to one side, draw a line which shows which way shot will move.	

Objectives	Suggested Activities	Notes
	Place a paper cup next to line. Pull shot again, carefully let go. Observe shot for about 1 hour.	
	. Sketch the eliptical orbit of earth by using a string with a 36 cm. loop, cardboard and two pins 15 cm. apart. Put pencil in loop, keep string taut as you sketch.	
Or 3.15 List several ways that man has "seen" his solar system throughout history.	. Make a model of different planets showing their relationship to the sun as seen by Copernicus.	
	. Research how the different planets received their names.	
	. Make a sketch or a model of the universe as Ptolemy saw it.	
Or 3.16 Identify, explain and list the chemical classes of minerals.	. Chemically test and explain the differences in the composition between gypsum, quartz, biotite, halite, galena, graphite, pyrite and calcite.	

LEVEL THREE

LIFE SCIENCE

CHANGE

Level Three (6-8), Life Science
Our environment, living and nonliving, microscopic, and macroscopic, is constantly undergoing change.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch 3.10 In nature changes constantly occur in habitats that result in changes in the organisms that live there.		Use film, A Light in Nature, Shell Oil Co. Shows scientists at work on frontiers of knowledge from satellites to bathyscaphe and from bevatron to radio telescope.
Ch 3.11 Describe the organisms that make up the local climax community.	. Make a trip to a wooded area. Note the variety of organisms that make up the community. Compare it with an undisturbed field, or an established climax deciduous woods. (Delaware Nature Center Wood lot almost climax.)	
	. Make a display that compares life span of various organisms found. Use a bar graph to compare average life spans. Develop a lesson on population controls and survival curves. . Record population number in a small nearby area. Keep seasonal records and use for comparison from one year to next.	
	. Research other Delaware habitats: salt water marsh, ocean, and beach communities (Newark AT on Salt Marsh).	AT 574.92 S An imaginary trip through a marsh

Objectives	Suggested Activities	Notes
	. Influence of varying salt concentrations on England (lab on file). . Protective coloration (lab on file). . Distribution of microorganisms around the school building (lab on file).	
Ch 3.20 Man's technological know how has brought about great changes in his environment. Ch 3.21 Trace what happens when man changes the habitat of organisms.	. Identify places in the community where conservation practices might be improved . Investigate what steps local industry has employed to meet conservation requirements.	Careers: Conservation officer Ecologist Entomologist Herpetologist Ichthyologist Zoologist
	. List the present animal species found in local rivers, streams, woods and compare it to records of 50-100 years ago. . Have a bulletin board of recently extinct species. Add to it the investigations of students in establishing an endangered species list. . If the factors for extinction are identified, try to determine what is being done to change the pattern leading to extinction.	

Objectives	Suggested Activities	Notes
	. Discuss the need for state parks, national parks, forests, water area, nature sanctuaries and arboretums, and why their location is important. . Resource Guide to the film: Endangered Shore (Lesson plan on file). . Where have all the menhaden gone? (Lab on file.)	
Ch 3.30 A record of changes in plants and animals has been established through fossil studies.		Careers: Forest ranger Historical geologist Paleobotanist Paleontologist Paleozoologist
Ch 3.31 Describe the process of fossil formation.	. Have students make plaster molds and casts of plant parts or insects, shells, etc. . A fossil hunting field trip. (Earth Science, See Objective D3.130 and activities) . Display fossils, pictures of fossils, visit a museum collection.	Films: Story in the Rocks (Shell Oil), Fossil Story (Shell Oil), This Land (Shell Oil), Dr. Leakey and the Dawn of Man (Aetna Insurance)
Ch 3.32 Students will trace historical record.	. Use slides and filmstrips to review the historical record. . Fill in a time-record chart with major plant and animal changes. . Create classroom murals of geological periods. . Using references trace development of the present-day camel, (elephant, dog, cat, horse, etc.). Prepare bulletin board of pictures or drawings of the animals "family tree."	

Objectives	Suggested Activities	Notes
Ch 3.40 All forms of life have common ancestral backgrounds as evidenced by the fact that they all possess characteristics which are common to other forms.		Careers: Biochemist Biology teacher Biophysicist
Ch 3.41 List and describe characteristics that all living things have in common which distinguish them from non-living things.	. Observe and study several living things in and around the school and compare their characteristics to several non-living things in the immediate environment. . Find out if plants require the same nutrient materials as animals. Make a chart indicating the nutrient materials required by plants, by animals, and by both plants and animals.	
Ch 3.50 All living things are constantly undergoing change through the processes of genetic variability and natural selection.		

CONTINUITY

Level Three (6-8), Life Science
There is constancy in cause-and-effect relationships which preclude any abrupt reversal in natural phenomena.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Co 3.10 Scientific principles are based on observing, hypothesizing, experimenting, recording and interpreting data.		Careers: Botanist Fish and wildlife service Game and farm management Gardener Geneticist Horticulturist Zoologist
Co 3.11 Identify the variable and the control in an appropriate experiment.	. Contrast the concept of spontaneous generation and biogenesis. Duplicate in class or show by illustration Pasteur's experiments supporting biogenesis. Emphasize experimental procedures used in "modern" science.	
Co 3.12 Distinguish between statements that are hypotheses and those that are not.	. Compare the work of Lamarch with the work of Mendel. Present basic ideas of Mendel's hypothesis	
Co 3.20 Basic characteristics of organisms are transmitted to the organisms being produced.	. Students will choose hypotheses from a list of statements. . Present genetic symbols. . Show illustrations of phenotypes with appropriate genotype.	Careers: Animal pathologist Biochemist Geneticist Plant pathologist
	. Consult with health teacher to correlate genetic study.	See district Health Curriculum Guide
	. Conduct simple population genetic studies, such as PTC tasting, blood typing, tongue curling, etc.	

Objectives		Suggested Activities	Notes
Co 3.21	The student will participate in an individual or class experiment to show genetic transmission.	. Have a class experiment to run during genetics study. Plant seeds of an F_2 single character cross. (Albinism or dwarfness in corn) or obtain pure fruit fly cultures for a single character (eye color, wings - not sex-linked) and mate virgin flies with wild type for two generations. Record data, form hypothesis and compare with results from other classes.	Films: The Thread of Life (Bell Tele.) Mendel's Laws (DPI)
Co 3.22	From a study of meiosis the student will describe how organisms transmit inherited characteristics.	. Use A.T. on Mitosis/Meiosis . Discuss sex-determination and sex linkage.	AT Mitosis 574.87 H AT Meiosis 574.87 Hm
Co 3.23	Students will recognize that changes in hereditary material result in inherited changes.	. Discuss chromosomal mutations. . Have photomicrographs of chromosomes and chromosome maps. . Explore DNA and the results of a change in DNA - gene mutation. . Explore sickle-cell anemia or other inherited disorders.	
Co 3.24	Describe how man uses genetic studies for breeding of plants and animals.	. Use resource people from University of Delaware Department of Agriculture for research programs there - tomato wilt, etc.	Consider a trip to Dept. of Agriculture at Beltsville, MD

Objectives	Suggested Activities	Notes
Co 3.30 Plants exhibit behavior that is hereditary.		Careers: Biochemist Botanist Farmer Horticulturist Nurseryman
Co 3.31 Locate areas of rapid growth in a bean plant.	. Conduct an experiment to determine where growth takes place in a root. . Root growth (lab on file).	
Co 3.32 Observe the effect gravity has upon the direction of stem growth.	. Conduct an experiment to determine what effect gravity has upon plant growth.	
Co 3.33 Observe how a controlled source of light affects the growth of a green plant.	. Conduct an experiment to find how plants respond to light.	
Co 3.34 Determine the effect of gibberellic acid on the growth of corn seedlings.	. Conduct an experiment to find the effect gibberellic acid has on plant growth.	

DIVERSITY

Level Three (6-8), Life Science
The vast number of natural phenomena which can be observed display a wide variety of similarities and differences.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
D 3.10 Living things perform basic functions which must occur together to be considered alive. D 3.11 From laboratory demonstrations, text and class discussions, the student will describe the chracteristics of a living organism.	. Use simple experiments to show each characteristic. Respiration: Fill several test tubes 1/4 full of a liquid CO_2 indicator. Place screen over liquid and place in one tube a live insect, another a rock, another germinating radish seeds, another non-germinated seeds. Cork and observe results. Growth: Observe radish seeds on wet paper toweling. Feed a caterpillar (Monarch) on milkweed and measure length of leaves, weight intake and caterpillar; observe insect excrement - excretion. Stimuli: For touch - plant mimosa pedunca. Also, earthworm behavior (lab on file). Temperature: Show effect of varying temperature on earthworm hearts. Reproduction: Have student collect various local plant seeds; have a bulletin board display of animals and young, bring in egg cases, cocoons, etc.	Careers: Biological aide Biology teacher Botanist Gardener Nurseryman Basic Life Science Teacher's Manual

Objectives	Suggested Activities	Notes
	. Seed germination (lab on file).	
D 3.20 Living things are organized into groups by differences in structure.		Careers: Algologist Biochemist Botanist Ecologist Entomologist Forest ranger Nurseryman Taxonomist
D 3.21 By comparing various systems of classification, the student will identify the major criterion for the establishment of classification levels.	. Determine the weakpoints in the classification systems of Aristotle, Latin descriptions of Middle Ages, and John Ray's system. . Compare Linnaean system of 1700's with the use of binomial nomenclature today. . List classification system groupings of Kingdom, Phylum, Class, Order, Family, Genus, and Species. Using references classify several common plants and animals. . List common names of various plants and animals in the community. Using reference books, find scientific name. Try to find out what scientific name means. Does it describe specimen? . Linnaeus and I (lab on file). . Differences in living things (lab on file). . Leaf type veination (lab on file) . Woody stem - external structure (lab on file). . Hydra lab sheet (lab on file).	

Objectives		Suggested Activities	Notes
D 3.22	Given the major classification kingdoms of plant, animal, and protist, the student will describe major characteristics of each.	. Find out if plants require the same nutrient materials as animals require. Make a chart indicating the nutrient materials required by animals, plants, by both plants and animals. . Make a comparison of plant and animal cells. . Observe Euglena specimens. . Draw or fill in a tree of plant and animal life. Use phyla names for branches. Have a class project for a permanent room-sized chart with pictures of representative organisms as well as names. Use as classroom reference source. . Monocot and dicot stems (lab on file). . Monocot and dicot seeds (lab on file). . Plant types (lab on file). . Plant and animal cells (lab on file).	
D 3.23	Describe and compare the life cycles of different invertebrates, vertebrates.	. Study life cycle and structure of selected invertebrates and vertebrates by direct observation, films, preserved specimens, charts, texts, etc. . Conduct a taxonomy lesson on animals by a trip to a zoo.	

Objectives		Suggested Activities	Notes
D 3.24	Compare the reproductive methods of plants and order them on the basis of complexity. (See also D 3.360)	. Observe algae in pond water.	Good diatoms from local clay bottom streams.
		. Collect various fungi plants and make spore patterns.	
		. Study mosses and observe fruiting specimens in appropriate season.	
		. Ferns: combine with above land species in a terrarium and maintain throughout school year.	An ecological walk thru White Clay Creek Valley
		. Make own miniature terrarium.	
		. Gymnosperms and Angiosperms, sexual reproduction: Make class collection of cones and fruit (nuts, seeds) for display and reference.	
		. Life Cycle of a Plant (EB film strip - lesson plan on file).	
		. Different parts of a fruit (lab on file).	
		. Pollen (lab on file).	
		. Seed dispersal (lab on file)	
D 3.25	Describe how a tree meets its basic needs.	. Use the Green Plant Unit. Biology Teachers Handbook for experiments on photosynthesis, root absorption, transpiration, tropisms, plant pigments, reproduction, growing pollen.	
		. Leaf anatomy - cross section of a leaf (lab on file)	

Objectives	Suggested Activities	Notes
	. Water tranport in a celery plant (lab on file). . Plants and gas (lab on file). . Transpiration in plants (lab on file).	
D 3.26 Using a tool of a taxonomist the student will be able to "key" an example of a local tree or insect.	. Using the dichotomous key for deciduous trees (Gwinn) or insect key identify as to the genus level for trees, order level for insects. After classroom study take walk on school or adjacent grounds and "key" trees. . Organize a classroom collection of tree leaf specimens and insect varieties, properly mounted and identified. A neighborhood map marked with collection sites would be helpful in later studies of ecology. . Students construct a key using preserved specimens.	Interaction of Man and the Biosphere - "Classification"
D 3.30 There are many ways in which living things reproduce. All of the processes may be classified as asexual or sexual.		Careers: Horticulturist Zoologist
D 3.31 Describe and explain the structures and functions in vertebrate reproduction.	. Dissect a male and female frog and make a diagram showing the parts of their reproduction system and explain the role played by each part.	

Objectives	Suggested Activities	Notes
D 3.35 Investigate how non-flowering plants reproduce.	. Collect and observe living plants until you locate ones which are preparing to, or are, reproducing. . Construct diagrams or models to explain how these forms of life produce more of their own kind.	
D 3.36 Determine what parts of a flower are concerned with the process of reproduction.	. In a living plant locate the parts involved in sexual reproduction. . Make a diagrammatic sketch showing these parts, label each part and explain its role in reproduction.	

INTERACTION

Level Three (6-8), Life Science

The interactions of living and non-living matter in an environment and the resulting exchange of energy determine the nature of the environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
I 3.10 Living things exist in an environment that is affected by a wide range of physical factors.		Careers: Botanist Ecologist Fisheries scientist Horticulturist Range scientist Soil scientist Water resource investigator Wildlife technician
I 3.11 Recognize how the factors which make up the physical environment affect various living organisms.	. Present a study on physical substances: soil, water, air pressure, gravity, conditions of light and temperature. . Analysis of aquatic ecosystems (5 labs on file). . Effects of DDT on Osprey reproduction (lab on file).	
I 3.12 Investigate the effect of one of the physical factors on a living plant.	. Present a number of basic experiments to show role of soil, temperature, air, light, water on germinating seeds. . Have students vary resource experiments and present original thinking. Review procedures from Continuity Unit on controls, variables, recording data and interpretation. . Experiments to show the effects of phosphates and pollutants on plant growth.	See Green Plant Unit, Biology Teacher's Handbook

Objectives	Suggested Activities	Notes
I 3.13 Demonstrate the ability to record information by constructing a graph using data containing two variables.	. Set up class experiment that involves two measureable factors (ex. temperature, water) and see effects on root length of a germinating bean, pea seed. Have class graph results.	
I 3.14 Demonstrate a method for analysis of a system by identifying source of the problem and describing a method to test for each problem identified: e.g., a seed that will not germinate.	. Plant treated and untreated parsley seeds and analyze results.	Student should recognize basic experimental procedure and the basic need of a germinative seed in order to analyze this problem.
I 3.20 Living things affect other living things in an environment.		Careers: Environmentalist Fisheries technician
I 3.21 Identify examples of interaction between living organisms.	. Through slides, pictures, films, show examples of predation, commensalism, parasitism, mutualism. . Dissect intestinal tract of termite to view protozoan. (Maintain chemical internal environment on slide.)	Contact secretary of DNEC or Division of Natural Resources for speakers, beekeepers, fish and wildlife officials, entomologists, etc.
I 3.22 Identify ways in which plants and animals compete for basic needs in their environment.	. Use physical factors to show competition among plants. (crowding of seedlings on limited soil; limited water, light, etc.)	

Objectives	Suggested Activities	Notes
I 3.23 Construct a diagram or model to show the pattern of transfer of energy from organism to organism.	. Distinguish how man is directly or indirectly dependent upon the soil.	
	. Choose a specific local herbivore or carnivore and trace its food chain back to the primary producer and any other consumer.	Use the Audobon Food Chain Charts
	. Use AT on Food Chains and Food Web.	AT 591.53 H Ecology-Energy Relationships
I 3.24 Students will be able to interpret an illustration of various cycles involving living things such as water, carbon and oxygen cycles.	. Construct a cycle on feltboard making their own illustrations and demonstrate to class members.	
	. Use AT on Cycles.	AT 591.51 J Cycles
I 3.30 Organisms are found living together in relationships which are mutually beneficial, mutually detrimental, or beneficial to one at the expense of the other.		Careers: Biochemist Dietician Ecologist Entomologist Hydrologist Ornithologist
I 3.31 Investigate how plants help other plants.	. Find a sweet clover, alfalfa and/or soy bean plant. Carefully dig up the plant and wash away the soil from the roots. Dig up a few other kinds of plants and compare their roots to the clover, alfalfa and soy bean.	
	. Prepare a report pertaining to how alfalfa, clover, and soy beans help other plants.	

Objectives		Suggested Activities	Notes
I 3.32	Research how plants help animals.	. Design and conduct an experiment to determine if oxygen is given off during photosynthesis. . Take a trip to a nearby park, woods or meadow. Observe and list as many ways as possible in which plants are helping animals.	
I 3.33	Determine how plants help man.	. Compare the amount of water which flows away during a rain from an area covered with grass with an area which has no vegetation. Account for this difference. . Make a list of plants which served you in some way yesterday, and indicate the use you made of the plant. . Make a report on how the following plants help man: yeast, sassafras, pine tree, flax, rose, spearmint, castor bean, cassava, poppy, cactus, chinchona, camphor, hemp, quinine, ebony, cotton, indigo, Spanish moss, and algae.	
I 3.34	Animals help plants.	. Take a field trip to find ways animals help plants. . Make a list of ways animals help plants.	
I 3.35	Animals help each other.	. Locate an ant hill. Observe ants leaving and returning to their nest. Observe and record what they do. What do ants do when their nest is destroyed?	

Objectives	Suggested Activities	Notes
I 3.36 Animals help man.	. Watch birds feeding. Record what they are eating. Estimate their daily food intake.	
	. Prepare a report in which you tell of the benefit to man of honeybee, silkworm, whale, oakgall, ladybug, dog, cow, scale insect, brachonid wasp and carrion beetle.	Contact Delaware Beekeepers Association
I 3.37 Plants can hinder other plants.	. Examine fruits, vegetables and the leaves of these plants for diseases; examine the plants carefully to determine if it is the surface only which is damaged.	
	. Make a list of the effects of fungus diseases on plants.	
	. Find as many examples of plants hindering other plants in your neighborhood as you can. Try to obtain pictures of what you see, and report to the class.	
	. Examine dodder.	
I 3.38 Plants hinder man.	. Make a report on examples of how plants hinder man.	
	. List some ways you have been injured by plants.	
	. Collect and identify weeds which hinder man. Also list how they hinder man.	
I 3.39 Animals hinder other animals.	. Make a report and poster on ways animals hinder other animals.	

Objectives	Suggested Activities	Notes
	. Visit a flower garden, vegetable garden, cultivated field, and a forest, and make a collection of plants or parts of plants which have been damaged or destroyed by insects.	Visit University Insectory

LIMITATION

Level Three (6-8), Life Science

Natural phenomena are limited by the fundamental nature of matter and energy. There is an overall tendency toward random distribution of energy and a corresponding tendency toward equilibrium in an environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
L 3.10 The biotic community is in dynamic equilibrium dependent on changes in solar energy and available matter.		Careers: Biophysicist Botanist Climatologist Entomologist Ornithologist
L 3.11 Identify five different biomes and give examples of major plants or animals that live there.	. Use films and filmstrips to show biomes: plants and animals. . Color-code the biomes on a world map. Compare insolation factor by latitude and altitude. . Compare biomes by physical factors and draw similarities: arctic, desert, water-availability, humidity, temperature. . Consult with social studies teacher to correlate terminology, etc. with lessons in geography.	
L 3.12 Describe the changes in local plants and animals as the seasons change.	. Make a bulletin board of pictures of local trees, plants, insects, etc. taken during the four seasons. . Have students collect seed pods, press plant leaves, flowers, as a seasonal project for display.	

Objectives	Suggested Activities	Notes
	. Have students keep a diary of a season: e.g., Spring: record average temperature of the week; record first leaves or flower buds on trees; first insect activity, migrating birds, rainfall, etc. Use photographs to show changes in a specific small area.	
L 3.20 Patterns and rhythms in nature are responses to maintain equilibrium.		Careers: Ecologist Forester Game warden Oceanographer
L 3.21 Compare seasonal patterns in various biomes.	. Have students investigate how plants and animals adapt to the changes in the biome area: Wet, dry; marine biome - e.g., changes in plankton growth as seasons change, tidal patterns. . Have students investigate migratory patterns of birds, eels, whales, seals, etc. . Students investigate hibernation and aestivation.	
	. Compare bird beaks and claws to their respective environments to predict where unknown birds will live.	Use Audobon Charts of beak and claw types
L 3.22 Investigate the relationship between seasonal patterns and the reproductive cycle of plants and animals.	. Have available articles on reproductive cycles and life histories of plants and animals. . Investigate tidal patterns in the reproduction of grunion and Atlantic fireworm.	(Basic Life Science Chapter 4 & 5), Science World Magazin

Objectives	Suggested Activities	Notes
L 3.23 Define "biological clock."	. Investigate how periods of light and darkness affect the growth of plants.	Basic Life Science, page 88.
	. Investigate effect of period of light on insect life cycles and vertebrates, i.e., salmon and migration of birds.	Basic Life Science, page 98
L 3.30 The physical environment limits the life forms which can exist within it.		Careers: Biological aide Biophysicist Environmentalist Gardener Horticulturist Nursery man Taxonomist
L 3.31 Describe how various factors such as soil, water, air, temperature, and light, which make up the physical environment, affect or limit life-forms that exist in that area.	. State ways in which living things are related to air, water, soil, food, minerals, light and heat. . Name five places or conditions in which little or no life appears. . Conduct an experiment to determine how much oxygen a man uses in a day. . Set up an experiment to show what happens to corn or potato plants when the oxygen supply is cut off from the roots (cover roots with water). . Obtain some decaying wood and devise an experiment to show that the process of decay produces carbon dioxide.	Film: "Delaware and its Soils" (DPI)

Objectives	Suggested Activities	Notes
	. Conduct an experiment to show that plants and animals add water vapor to the air. . Conduct an experiment to show how the humidity of the air affects the rate of evaporation of water and temperature of a moist body. . Conduct an experiment to determine if germinating seeds need water. . Conduct an experiment to determine what are some factors which determine the heating effect of radiant energy from the sun. . Conduct an experiment to find how heat affects the growth of micro-organisms. . Conduct an experiment to determine if light is necessary for the growth of green plants. . Explain why rosebuds keep better in a refrigerator than in a warm room. . Why is it more difficult to exercise at high altitudes than lower altitudes?	Contact a local farmer as a guest speaker.

Objectives	Suggested Activities	Notes
	. Take a trip to a park or woods. Observe and identify the kinds of plants which grow in the shade. In what ways do they differ from plants which grow in direct sunlight? Do you find the same kind of plants growing on the north side of large trees as you do on the south side? How do you explain the difference? . The Undesireables (lab on file). . Humidity and the Dew Point (lab on file). . Photosynthesis (lab on file).	

ORGANIZATION

Level Three (6-8), Life Science
Systematic relationship exists in natural phenomena. Systems within systems comprise the universe.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Or 3.10 The microscope is a basic instrument for studying small living units.	. 3 labs on file	Careers: Biological aide Laboratory technician Microbiology technician Nurse
Or 3.11 Demonstrate the ability to properly use, handle and care for a microscope.	. Draw and label parts of a compound microscope. . Demonstrate and show pictures of other classroom and scientific tools of magnification: micro-projector, electron microscope, etc.	8.17 Equinox
Or 3.12 Mount a slide on the stage of a microscope and focus the scope using both low and high power objectives.	. Demonstrate the proper way to prepare a wet mount. Make slides from elodea, onion, cheek cells, etc. (Lab on file.) . The student should focus on low and high power and sketch what he sees. He should be able to relate field of vision and depth. (Lab on file.)	8.18 Equinox
Or 3.13 Given a diagram of a generalized plant or animal cell, the student will identify those structures visible using a compound microscope.	. Make an onion skin slide and identify the cell membrane, cytoplasm, nucleus and vacuoles. . Make an elodea leaf slide and identify chloroplast, nucleus, vacuoles and cell wall. Note cytoplasmic streaming.	

Objectives	Suggested Activities	Notes
	. Make a model of a cell using materials found at home. (Plastic boxes, clay, string or bags, etc.)	8.54 Equinox
Or 3.20 Living things are composed of cells that vary in size and structure.		Careers: Cytologist
Or 3.21 Make a comparison of plant and animal cells by structure.	. Compare and contrast a plant and animal cell specimen under the microscope or use micro-projector as a class activity (lab on file). . Using resource materials sketch or label a diagram of the parts of a generalized plant and animal cell. . Cell structure (lab on file).	
Or 3.22 Describe the function of the parts of a generalized cell.	. Have students act out function of key cell structures: nucleus, direction of activities - cell membrane and its selectivity, etc. Bring out as a summation that most all of the basic functions of life are represented. (Excretion, movement, respiration, reproduction, etc.) . Set up experiments to demonstrate permeability and osmosis (2 labs on file).	

Objectives	Suggested Activities	Notes
	. Stucture and function in a plant cell (lab on file).	
	. Chloroplasts (lab on file).	
Or 3.30 New cells are produced by two different but related processes.		
Or 3.31 Compare and contrast the production of new cells by mitosis and meiosis.	. Use prepared slides of mitosis in starfish eggs, ascaris, etc. to show stages of cell division necessary to produce a cell of similar characteristics.	
	. Have available the Newark produced AT program on Mitosis and Meiosis.	AT Mitosis 574.87 H AT Meiosis 574.87 Hm
Or 3.40 Unicellular organisms function as independent living things, multicellular organisms function as specialized cells that work together and depend upon each other.		
Or 3.41 Unicellular organisms function as independent living things.	. Water drop zoo (lab on file).	

Objectives	Suggested Activities	Notes
Or 3.42 From a study of cellular organization the student will distinguish the complexity of tissues, organs and systems.	. Have a bulletin board of pictures and models of unicellular organisms and colonies, and multicellular organisms as tissues, (i.e., muscle tissue, bone cells). . Mascerate muscle tissue in nitric acid and plant conductive tissue from stems. (Jeffrey's liquid) Stain and view fragmented tissue under microscope. . Masceration of plant tissue (lab on file).	
Or 3.50 Specialized cells in living things work together and are modified to perform special functions.		Careers: Botanist Zoologist
Or 3.51 Observe the different types and numbers of cells bound in the epidermis of several different leaves. Learn how these cells work together to perform their function.	. Conduct an experiment to find what different kinds of cells are found in the epidermis of leaves.	
Or 3.52 Observe the different types of cells and tissues found inside a leaf. Learn how these cells function together to carry on photosynthesis.	. Conduct an experiment to find what special cells and tissues may be found in a leaf cross section. . Chlorophyll (lab on file).	

Objectives	Suggested Activities	Notes
Or 3.53 Observe how several tissues or organs work together in an organism to carry out special functions.	. Conduct an experiment to find what special structures are visible in the organ systems of an earthworm, frog, etc. (5 labs on file). . A comparative study of clam and squid (lab on file).	
Or 3.54 Locate the different organs in the digestive system of an organism. Relate the structure of the digestive organs to their function in the organ system.	. Conduct an experiment to determine what organs may be found in the digestive system of an earthworm, frog, etc.	
Or 3.55 Identify major organs and systems of the human body and their functions.	. Using a model of the human torso locate and identify the organs of a system.	

LEVEL THREE

PHYSICAL SCIENCE

CHANGE

Level Three (6-8), Physical Science

Our entire physical environment is in a constant state of change. Living and nonliving, microscopic as well as macroscopic are effecting changes which are sometimes immediate, sometimes distant.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Ch 3.10 Nature is constantly influencing changes in our physical environment.		Careers: Chemist Experimental vehicle driver Laboratory technician Metallurgist Paint and dye worker Physicist Race driver Rocket designer Teacher
Ch 3.11 State an operational definition of a variable.	. Give several practical examples of a variable; define variable operationally. . Plot variable in relation to time. Example: water boiling in a beaker, change in temperature related to time. . Students can select a variable from an experimental design.	
Ch 3.12 State and distinguish between physical and chemical properties of a given substance.	. Given several basic elements, zinc, magnesium, sulfur, copper-compare physical and chemical properties in various states: as is, heated, in acid, in water. Make observation before, during and after each stage. . Activities related to elements: generation of hydrogen, generation of oxygen.	
Ch 3.13 State an operational definition of acceleration and deceleration.	. Use a watch to time how long it takes for an object to fall 2 metres, 8 metres, and 32 metres.	

Objectives	Suggested Activities	Notes
	. Make an accelerometer to find out when a vehicle is accelerating or decelerating. . Calculate the acceleration of a marble and steel ball rolling down a wooden grooved track. . Acceleration of a falling ball (lab on file). . Gravity's affect on the motion of falling bodies (lab on file).	See page 173 - Exploring Physical Science
Ch 3.20 Man acting with or against nature can change his physical environment in both a negative and positive way.		Careers: Lens grinder Mirror maker/installer Optometrist Physicist Telescope repairman
Ch 3.21 Identify plane, convex and concave reflectors and describe what each does to light rays striking them.	. In a "lightbox," place a piece of smooth aluminum foil as directed. Change shape of foil and note paths of light. . Make a reflector from an overhead projector. Test reflector by putting a flashlight lamp at focus to see if the light is reflected outward in parallel beams. . Use a light meter to register light reflected from different surfaces.	See page 254, Exploring Physical Science

Objectives	Suggested Activities	Notes
Ch 3.22 Describe and demonstrate how a prism affects a light ray.	. Study light as it passes through one prism. Pass light from one prism to another, try different light sources. . Make a chart to show part of light through binocular field glasses. Show location of lenses and prisms identifying type and explaining purpose of each.	
Ch 3.30 Forms of matter and energy are constantly changing. Ch 3.31 Describe and demonstrate how energy is transformed from one form to another.	. Design an experiment illustrating transformation of energy. Example: zinc and copper sulfate reaction. . Make a chart showing energy changes that take place. Example: sun to a lighted bulb. . Perform activities which show how various forms of energy can be released through oxidation. Examples: $2Mg + O_2 \longrightarrow 2MgO$, $2H_2 + O_2 \longrightarrow 2H_2O$. Measure potential energy of a spring attached to a wall before and after stretching. . Make posters with pictures in two columns, one side for those that represent potential energy and one for kinetic energy.	Careers: Nuclear engineer Oil refinery technician Oil well driller Solar engineer Tank cleaner

Objectives	Suggested Activities	Notes
	. Electrical energy transformed to electromagnetic energy (lab on file). . Electricity, heat, light and motion (lab on file).	
Ch 3.32 State the Laws of Conservation of Matter and Energy and identify some of the exceptions that are known today.	. Given a simple chemical reaction write an abbreviated statement either in words or in symbols indicating changes that take place. Example: seashell pieces in a sealed plastic bag with hydrochloric acid. . Activities in ionic and covalent bonding.	See ISCS textbook
Ch 3.33 Describe how matter on earth is constantly undergoing change.	. Describe and illustrate methods that man can use to conserve heat energy. . Conduct series of activities to show how matter is changed.	
Ch 3.40 Physical changes occur when there are changes in the position and motion of particles of all sizes which bring about different relationships between particles without changing the composition of the matter.		

Objectives	Suggested Activities	Notes
Ch 3.41 Observe physical changes and learn several methods of reclaiming the original materials from the mixture.	. Conduct a series of experiments showing physical changes. Examples: melting ice, cutting paper, breaking chalk, etc. . Physical and chemical changes (lab on file).	
Ch 3.50 Chemical changes involve energy exchange. Also, changes take place between particles within molecules or crystals of matter.		
Ch 3.51 Observe several chemical changes and learn how to recognize a chemical change.	. Conduct a series of experments on how to determine if a chemical change takes place. . Experiments to demonstrate chemical changes. Examples: a. burning a match b. carbon dioxide and limewater c. saliva, starch and sugar d. zinc and copper sulfate e. sulfuric acid and sugar f. potassium iodide and lead nitrate	

CONTINUITY

Level Three (6-8), Physical Science

There is a constancy in cause and effect relationships which precludes any abrupt reversal in natural phenomena.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Co 3.10 Laws of gravity, motion and matter appear to be constant. This provides nature with a constant continual action.		Careers: Aerospace engineer Airplane pilot Astronautics Astronomy Car, boat, plant designer Nuclear physicist Security person
Co 3.11 Demonstrate ability to read and construct the appropriate graphing system: bar, line or circle, using data containing two variables.	. Give pertinent information relative to plot, example: population increase, oil depletion, fuel adjustment cost, etc. . Whenever an experiment permits it, include an accurate graph conveying information derived.	Population education lesson: Car Versus the Bus.
Co 3.12 Identify, manipulate and operationally define an independent and dependent variable.	. Label independent and dependent variables in such activities as: light on eye heating air in balloon level of water on tone of drinking glass distance on force exerted by magnet	
Co 3.13 Identify ways that indicate gravity to be the most common force in nature.	. Compare rate of fall for projected object and for dropped object.	

Objectives	Suggested Activities	Notes
Co 3.14 Describe and demonstrate the basic Laws of Gravitation: Newton's First Law Newton's Second Law Newton's Third Law	. List forces which make work difficult to do. Designate them by the terms gravity, inertia, and friction. . Write biographical sketches on some of the men responsible for our knowledge of gravity. . Sketch and label various "perpetual motion" machines. . Place object on tablecloth, then pull cloth away quickly. . Place coin on cardboard over glass; use finger to snap card off of glass. . List a number of everyday happenings which may be attributed to inertia. . Use a spring-balance to compare the force needed to accelerate objects of different masses. . Throw a ball while standing on a skateboard. . Use example of person shooting a gun on iceskates. Determine relationship to Newton's Third Law. . To show some affects of inertia (lab on file).	See IME text for activities. Pendulation toys and models.

Objectives	Suggested Activities	Notes
Co 3.20 In our physical world there exists a relationship between matter and energy enabling it to be continuous.		Careers: Electronics engineer Electronics technicia Laboratory technician Nuclear engineer Optometrist
Co 3.21 Describe the relationship between matter and energy that is evidenced in a nuclear reaction.	. Describe in simple terms action taking place in nuclear reactor. . Set up dominoes or mousetraps to demonstrate chain reaction. . Visit Peachbottom atomic energy facility. . Compare nuclear fuel with standard fuels for cost, pollution, etc. . Using Einstein's theory, $E=mc^2$ show how small mass can be converted to high amount of energy.	
Co 3.30 Nature and man have given us very reliable, constant, and predictable phenomena to study, form hypotheses and base conclusions.		Careers: Civil engineer Hydraulics technician Optometrist
Co 3.310 Construct parallel and series circuits showing advantages and disadvantages of each.	. Connect three 1.5 V drycells to a voltmeter in series and in parallel circuits and record resulting voltage in each case.	

Objectives	Suggested Activities	Notes
	. Connect lamps attached to a battery in series constantly making observations as additional lamps are added. Repeat using a parallel system. Diagram and compare sketches and results. . Conduct activities with electrical models. . Series and parallel connections (lab on file).	
Co 3.32 Demonstrate that light passes in a straight line except when passing from one medium to another.	. Place a coin in the bottom of cup. Push cup away from you until the coin is hidden by the edge of cup. Have someone pour water into cup. Describe what you see. . Fill aquarium with water to which a few drops of milk has been added, shine a beam of light through water. (The milk shows the path of the light passing through the water.) Smoke or chalk dust can be used to show path of light in air above aquarium. . How are light rays bent? (Lab on file) . Refraction of light (2 labs on file).	

Objectives	Suggested Activities	Notes
Co 3.33 Demonstrate relationship between level arm, force applied and resistance.	. Given a wooden board, a fulcrum and another student (resistance) use this material to find easiest way to lift student. . Given above example calculate mechanical advantage. . Given resistance on a certain point of bar, demonstrate several ways to "balance" bar. . Prepare demonstration to illustrate classes of levers. . List various instruments which use principle of a lever.	
Co 3.34 Demonstrate method of determining specific gravity of an object.	. Research specific gravities of various elements and plot on graph. . Use hydrometer to determine specific gravity of an automobile storage battery fully charged, not fully charged. . Use hydrometer to estimate freezing point of antifreeze and water. . Given quantity of sea water and an equal quantity of pure water determine specific gravity of sea water. . Classify objects using specific gravity as one of categories.	Use extreme caution when using automobile battery.

Objectives	Suggested Activities	Notes
Co 3.35 Demonstrate method of determining density of an object.		
Co 3.40 Heat energy tends to move from region of high temperature to region of low temperature.		Careers: Aeronautical engineer Annealer Biochemist Chemical engineer Civil engineer Geologist Geophysicist Laboratory technician Metallurgist Meteorologist Mining engineer Nuclear engineer Physical chemist Pollution recycling technician Processing engineer
Co 3.41 Demonstrate effect of heat on solids, liquids and gases.	. Conduct experiment to determine what happens when heat energy is added to solids, liquids and gases. . Expansion and contraction of matter (2 labs on file).	
Co 3.42 Discover that different materials have different heat capacities.	. Conduct experiment to measure amount of heat energy gained by different materials. Compare results.	
Co 3.43 Investigate exchange of heat energy between hot and cold forms of matter.	. Conduct experiment to determine if heat energy lost by hot water compares to heat energy gained by cold water. . Design an experiment to measure heat loss from water to air. . Conduction of heat (lab on file). . Heat by radiation (lab on file).	

Objectives	Suggested Activities	Notes
Co 3.50 In chemical changes matter is conserved, and the number of atoms of each element involved remains the same.		
Co 3.51 Show relationship between mass of the reactants and mass of the products in a chemical reaction. Observe any different properties of products of a chemical reaction.	. Conduct an experiment to learn if matter is conserved in a chemical reaction. . Activities to demonstrate types of reactions: direct combination, simple replacement, double replacement and decomposition.	See ISCS, Chapter 2

DIVERSITY

Level Three (6-8), Physical Science

Many phenomena in man's physical world can be observed displaying a wide variety of similarities and differences.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
D 3.10 In using scientific method to investigate one's physical environment, man must be careful to categorize and differentiate between various findings: observations, hypotheses, inferences, etc.		Careers: Carpenter inspector-maintenance Electrical inspector Equipment inspector Meteorologist Testing and regulating technician
D 3.11 Distinguish statements which are hypotheses and those which are not.	. Research, identify and state the hypotheses of men of science at various times in history. . Use list of statements from a recent experiment or event and identify those which are hypotheses.	
D 3.12 Identify data collected from a test conducted by student which support or do not support one's hypothesis.	. After identifying the hypotheses of scientists in the past, identify and state ways in which statements about these persons were supported or contradicted. . Tell whether or not an individual's hypothesis was accepted or rejected during his lifetime/today. . Use an electric inference board to develop a hypothesis, then collect data as to how the board is wired.	

Objectives	Suggested Activities	Notes
	. Create a situation involving an appliance that does not work. List hypotheses for testing where the problem is (example: lamp that does not work). . Activities to develop student observation skills.	
D 3.13 Demonstrate a method for analysis of a system by identifying sources of the problems. Describe a method to test for each problem identified.	. Use several beakers, some containing bases and others acids. Distinguish the contents of each beaker, using litmus paper or phenolphthalein solution. . Use an electric circuit that does not work. Analyze and identify problems, then develop sequence and method for solving.	
D 3.20 Terms used by man to explain his physical environment are sometimes related in meaning.		Careers: Chemist Ecologist Geologist Instrument repairman
D 3.21 Distinguish between atoms and molecules; compounds and elements.	. Demonstrate the use of mercuric oxide to produce mercury and oxygen. . Draw or make models of molecules of compounds: water, ammonia, etc. . Trace through man's history his different ideas of atoms and molecules.	Caution' Use a hood''

Objectives		Suggested Activities	Notes
		. Make a compound. Example: iron plus sulphur. . Make molecule models using balls of clay or molecule model kits.	
D 3.22	Construct classification system whereby items can be identified on basis of observable properties.	. Classify various common objects based on color, texture, hardness, shape and/or size, magnetic/not magnetic, transparent/opaque. . Using litmus paper classify various chemical solutions.	
D 3.23	Distinguish between heat and temperature.	. Show the relation of temperature and heat by weighing 1.000 grams of water in a beaker and then placing the beaker over a flame. . Make a candle out of butter, placing a string in melted butter. Then light the string. Make analogy of butter as energy in form of candle and how your body uses heat energy of butter to help you keep warm and help you move. . Calibrate a thermometer.	Raising temperature 1 degree C. = 1 calorie of heat energy. See IME text
D 3.24	Describe the basic properties of all matter and energy.	. Select various objects which appear to be different. State ways in which one is common to another, two common to a third, all are common. . Select objects which are either solid, liquid or gas and compare them to light, sound, heat, etc. Are there things which these have in common?	

Objectives		Suggested Activities	Notes
		. Classify elements on the basis of student observation	
		. Classify elements on the basis of chemical properties, such as reaction to water and reaction to acid.	
D 3.25	Define element, compound, mixture, and state properties that distinguish one from another.	. Demonstrate that by heating mercuric oxide a breakdown occurs. Observe what happens when heated; observe what happens when heat is withdrawn.	Caution: use a hood!
		. Fill container with mixture of fine sand, pebbles, small stones, and larger stones. Mix together. Ask students for various ways to separate these again.	
		. Make observations, hypotheses and draw conclusions as to how a vacuum cleaner works removing dust and dirt from objects but emitting clean air.	
		. Distill sea water, salt water and wood.	
		. Set up a filter through which muddy water is poured.	
		. Research the discoverer and date discovered of each element on the periodic chart.	
		. Given a list of common compounds, state what elements are found in each.	
		. Compare the physical properties of compounds with the elements contained in them.	

Objectives	Suggested Activities	Notes
	. Mixtures and compounds (lab on file).	
D 3.26 Distinguish between physical and chemical properties of a given substance.	. Use metals such as zinc and magnesium strip. Make a series of tests to find reaction with water, acids, fire, etc. List physical reactions and chemical reactions. List physical/chemical properties found through different stages of the activities.	Use safety in handling acids.
D 3.30 Various forms of energy display many similarities as well as differences.		Careers: Aeronautical engineer Aerospace technician Boiler inspector Civil engineer Estimator and inspector Instrumentation tech. Laboratory technician Optometrist Physical chemist
D 3.31 Explain the difference between kinetic and potential energy.	. Use a main spring or spring which can be wound and then released. . Show a pendulum bob pulled to one side and then released.	
D 3.32 List various forms of energy and categorize them as to those which can be used directly from source, and those which must be used from an indirect source.	. Sketch the sequence in order from: solar energy, heat energy, nuclear energy, and chemical energy. . Make a sketch showing how equipment on a ship, plane, car, or space craft is provided with energy.	
D 3.33 Distinguish between concave-convex lens explaining how each affects light rays.	. Let sunlight pass through each lens onto a piece of paper. Move lens closer and farther from paper. Compare results. . Compare the focal distance of both lenses.	

Objectives	Suggested Activities	Notes
	. Research as to which type of lens would be used for a near-sighted as well as a far-sighted person. . Use a medicine dropper to put a drop of water on a loop of wire. Make the loop about 4 mm. in diameter. What type of lens is this? . Compare the various lenses nature has made - eyes of animals and man - with man-made lenses in telescopes, microscopes, projectors, and cameras.	
D 3.34 Demonstrate how estimated measurements (measurements not involving direct measures) are radically different, depending on the individual and his concept of that unit.	. Use object around the classroom and have students estimate in metric units - without moving from their seats - the length, width and weight of: floor, tile, chalk board, desk, window, etc. Record, compare, find average, compare average with actual measurement determined by teacher prior to activity. . Using objects around the classroom and a measuring device, have students measure in metric units the length, width and height. Record, compare, find average.	
D 3.40 Through his research and experimenting, man has contributed a wide variety of scientific knowledge.		

75

Objectives		Suggested Activities	Notes
D 3.41	Identify the contribution of famous scientists.	. Investigate the contribution of famous scientists: Dimitri Mendeleev, Rutherford, Bohr, Antoine Lavoisier, Joseph Priestly, Daniel Bernoulli, Robert Boyle, J.A.C. Charles, Lord Kelvin, Blaise Pascal, Archimede Isaac Newton, James Joule, Count Rumford, Oersted, Coulomb Van de Graff, Curie, Pauling.	
D 3.42	Investigate occupations relating to physical sciences.	. Write an occupational brief for the following related careers: Architect, civil engineer, nuclear engineer, physical chemist, mining engineer, optometrist, instrumentation technician, excavation technician, pollution recycling technician, aeronautical engineer, lithographer, lab technician.	

INTERACTION

Level Three (6-8), Physical Science

The interactions of living and non-living matter in an environment and the resulting exchange of energy determine the nature of the environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
I 3.10 Matter as well as non-matter, often has one nature when isolated, but sometimes takes on another nature or quality during or after an interaction.		Careers: Atomic physicist Biochemist Broadcasting tech. Disc jockey Dry cleaner worker Electronics engineer Geophysicist Land development tech Mining engineer Nuclear engineer Opthalmologist Optometrist T.V. - radio annou c
I 3.11 Identify constant and manipulated variables in formation of types of energy.	. Prepare a chart showing steps which appear to be constant in formation process of coal and other fossil fuels. Identify constant and manipulated variables. . Prepare a chart showing process of formation of a diamond and graphite - note similarities and differences.	
I 3.12 Demonstrate the need for a media to enable sound to travel.	. Have doorbell attached to cell. Complete circuit in normal atmosphere. Complete circuit in vacuum jar. . Graph approximate speed of sound through various media.	

Objectives		Suggested Activities	Notes
I 3.13	Determine by experiment effects of mass, size of arc and length of string on time required for the swing of a pendulum.	. By changing variables, complete a chart similar to the following making conclusions: (use 200 grams and 500 grams.) A. Distance From Rest Position / Round Trip Per Minute / Period (Seconds for one Round Trip) 20 cm. _____ _____ 15 cm. _____ _____ 10 cm. _____ _____ 5 cm. _____ _____ B. Length of String / Distance from rest Position / Round Trips Per Min. / Period 9 dm. 10 cm. _____ _____ 7 dm. 10 cm. _____ _____ 5 dm. 10 cm. _____ _____ 3 dm. 10 cm. _____ _____	
I 3.14	Identify problems and determine proper lens to be used.	. Given the focal point of a far-sighted person determine effects of a concave and convex lens. Show by use of models or diagrams correct lens as well as effect. . Repeat above for near-sighted individual.	
I 3.15	Demonstrate that white light is a combination of all colors of the spectrum.	. Allow a ray of light to pass through two prisms, the first forming a spectrum and the second combining all colors into white again.	

Objectives	Suggested Activities	Notes
	. Mix colors of light and mix same colors of paint pigments. Compare results. . Research the cause of rainbows. . 4 labs on file: light and spectrums.	
I 3.16 Demonstrate that when light travels through a more dense substance, it will slow down a small amount.	. Place two stirring rods in a beaker. Have rods form an "x." View rods from the side.	
I 3.20 Living and non-living matter and non-matter all interact to produce forms of energy.		Careers: Biochemist Biophysicist Electrical engineer Engineer-mining Entomologist Geologist Mover Service station attendant Truck driver
I 3.21 Identify how various living and non-living things produce energy.	. Draw a sketch of how animals and trees over a period of time produce fossil fuels. . Demonstrate how man can make electrical energy by using magnets and coils of wire. . Describe how an electric eel produces electricity. . Describe and illustrate how lightning bugs produce light. . Make a study of Franklin's experiments on lightning.	

Objectives	Suggested Activities	
	. Make a battery using copper, zinc, and a desk blotter dipped in an electrolyte. Check current using a voltmeter. . Make a battery from pennies and aluminum foil. Test with a milliameter. . 3 labs on file: electricity and magnetism.	
	. Design a system to test materials for electrical conductivity. . Conduct chromatography experiments.	
I 3.30 Force is needed to change either the speed or direction of a stationary or moving object.		
I 3.31 Determine how pulleys may be used as a simple machine.	. Lift a weight with a single pulley, moveable pulley, block and tackle, etc., comparing force or direction. . Using as many simple machines as possible, combine them in such a way that they all work in sequence to accomplish a given task. . Inclined plane (lab on file). . Lever (lab on file). . Pulley (lab on file).	
I 3.40 Electricity and magnetism are interrelated.		

Objectives		Suggested Activities
I 3.41	Demonstrate the relationship between electricity and magnetism.	. Attach terminals of a coil of insulated wire to ammeter; rotate coil in a magnetic field. Observe. . Wrap insulated wire around nail. Try 10 turns, 20 turns, and 30 turns. Attach terminals to dry cell. Bring head of nail to pile of tacks and observe. Compare results produced by different numbers of turns. . Wind 50 turns of insulated wire on 5 cm. piece of glass tubing. Attach terminals to dry cell. Use a compass to check magnetic field near coil. Reverse terminals and observe.

LIMITATION

Level Three (6-8), Physical Science

Natural phenomena are limited by the fundamental nature of matter and energy. There is an overall tendency towards random distribution of energy and a corresponding tendency toward equilibrium in an environment.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
L 3.10 Matter and energy in the universe is in equilibrium. Each form of matter and energy has specific properties and characteristics in a specific environment. If the environment changes or the matter or energy is placed in a different environment, the matter and energy will undergo changes in response to the new conditions and maintain their equilibrium.		Careers: Aerospace technician Boiler operator Boiler repairman Civil engineer Fuel truck driver Instrumentation tech. Lab technician Mining engineer Physicist Processing engineer Roofer Service station attendant
L 3.11 Explain how and why an object moving through its environment will give up energy to its surroundings until it comes to rest.	. Conduct experiments, record observations, and draw hypotheses pertaining to experiments with: Falling objects The natural condition of an object Speed Force - bending and stretching Friction (lab on file) Motion and force of gravity (lab on file) Acceleration (lab on file)	

Objectives		Suggested Activities
		Mass - compared to speed and acceleration Analysis of momentum (lab on file) Energy of motion Study of the pendulum
L 3.12	The phase of matter is determined by the temperature and pressure of its environment. In a given environment a material can have only one phase. If the environment is changed drastically, there may be a change in phase of the matter.	. Design and conduct experiments, record observations, make models and draw conclusions to explain the results of your experiments concerning: a. Calibrating a thermometer b. Water and ice c. Structure of water molecule d. Boiling temperature of water containing various solutes e. Behavior of matter under conditions of high and low temperatures
L 3.13	The rate at which heat energy can be exchanged between a given mass and its environment is limited by special properties of the mass.	. Conduct experiments, record results, develop models to explain the results and draw conclusions about experiments concerning: a. Energy transfer b. Heat storage c. Heat and temperature d. Heat and volume e. Heat and molecular attraction f. Heat flow (lab on file) g. Color and heat

Objectives	Suggested Activities
L 3.140 Electricity moves from one point to another when the difference in potential between the points is large enough to overcome the resistance. In this the changes lose energy to their surroundings.	. Conduct experiments, keep records, make models, and draw conclusions to explain the results of these experiments: a. How to produce an electric current. b. How to detect electric current. c. How to construct a galvanometer d. What factors affect the strength of an electromagnet? e. How to construct a simple electric motor f. How does an electric transformer work? g. What is an electrical circuit? (lab on file) h. How to measure electricity in a circuit. i. How do series and parallel power sources affect the flow of electrons? j. How to construct a simple chemical cell (lab on file).
L 3.150 Electricity and magnetism are interrelated	. Activities to show electromagnetic fields. Example: sprinkling iron filings in a magnetic field. . Activities of attraction and repulsion of a magnet.

ORGANIZATION

Level Three (6-8), Physical Science

A systematic relationship exists in our physical environment. Systems within systems comprise the universe.

OBJECTIVES	SUGGESTED ACTIVITIES	NOTES
Or 3.10 A relationship exists between sets of observations, hypotheses, and theories supported by these observations.		Careers: Chemist Lab technician Navigators Observer Sports announcer Teacher
Or 3.11 Construct hypotheses from a set observation.	. Presented an actual incident, list a number of observations as well as inferences which can be derived, stating which is an observation, which is an inference. Develop hypotheses based on the observations. . Given a kernel of unpopped popcorn, list a number of observations. Develop a hypothesis based on these observations as to what will happen to this corn when heated.	
Or 3.12 Use a periodic table to show how to find the mass and atomic number of an element.	. Make a chart showing when and by whom various elements were discovered. . Make a periodic table which shows elements: atomic weight and mass. . Make a diagram of the outer shell of various elements comparing this to atomic number diagrams.	

Objectives	Suggested Activities	Notes
	. Calculate number of protons, neutrons and electrons from the periodic table.	
Or 3.13 Demonstrate methods for measuring in the metric system. (Lab on file.)	. Identify characteristics of a measurement system such as standardization of units. . Give length of an object using a metre stick and metric units and report answer ± 0.5 cm. . Determine weight of an object using a pan balance and metric weights ± .1 g. . Demonstrate skill using a graduated cylinder ± 5 ml. . Learn to spell metric units in accordance with SI system. Ex.: <u>metre</u>, <u>litre</u>, etc.	
Or 3.20 The ability of matter to emit and absorb radiant energy is determined by the organization of electrically charged particles in the matter.		Careers: Lens grinder/polisher Observatory technician Optical instruments salesman
Or 3.21 Determine the pattern of reflection and the distance of images from reflecting surface.	. Conduct experiments on how light is reflected from various surfaces. (2 labs on file.)	

Objectives	Suggested Activities
Or 3.22 Study the path of light as it travels through water and air.	. Conduct experiments to show how light waves are bent as they travel through different media.
Or 3.23 Determine how lenses and prisms affect the path of a beam of light.	. Conduct a series of experiments to show how lenses bend light rays. . Conduct a series of experiments to determine how various types of metal filaments emit different intensities of light.
Or 3.30 Proper safety measures are important in the classroom.	
Or 3.31 The student constructs and handles laboratory apparatus in a skillful manner, giving due attention to accident prevention.	. Student produced safety posters should be displayed in room.

APPENDICES

APPENDIX I

RECOMMENDED TIME ALLOTMENT FOR SCIENCE

At the kindergarten level it is recommended that the teacher spend a minimum of 20 minutes three days a week exploring natural science with the students.

At the first grade level it is recommended that the teacher spend a minimum of 20 minutes five days a week exploring natural science with the students.

At the 2nd, 3rd, and 4th grade teaching level it is recommended that the teacher spend a minimum of 30 minutes a day five days a week exploring natural sciences with the students.

At the junicr high and/or middle school level, (grades 5 to 8) it is recommended that the teacher spend a minimum of 40 minutes a day five days a week exploring natural science with the students.

Instructional time spent in related areas of natural science such as health, drug, sex and/or emergency preparedness is not part of this basic time allotment.

This time allotment complies with the suggested time allotments adopted by the Delaware State Board of Education on May 15, 1969.

APPENDIX II

SCIENCE COURSES[1]

1. CONCEPTUALLY ORIENTED PROGRAM IN ELEMENTARY SCIENCE (COPES). 1972-1973. Morris H. Shamos, Department of Physics, New York University, 4 Washington Place, New York, New York 10003.

   Digest. COPES is a science program for students in grades K-6. The curriculum materials developed by the project consist, in the main, of teacher guides that provide understanding of the science involved and permit teachers to guide pupils through the student-oriented activities.

2. ELEMENTARY SCIENCE STUDY (ESS). 1962-1973. Joseph Griffith, Education Development Center, Inc., 55 Chapel Street, Newton, Massachusetts 02160.

   Digest. The Elementary Science Study project developed 56 units for use in science programs from kindergarten through the 8th grade. Each unit is designed to be used over a range of grade levels, depending on the scope and depth of the approach. ESS units do not comprise an elementary school science curriculum. Rather, teachers may select from them to construct a course to meet local needs or to supplement existing courses. Their adaptability enables use in conventional or "open" classroom settings.

3. SCIENCE CURRICULUM IMPROVEMENT STUDY (SCIS). 1962- . Robert Karplus, Lawrence Hall of Science, University of California, Berkeley, California 94720.

   Digest. The SCIS project has developed ungraded sequential physical and life science programs for the elementary school that are designed to turn the classroom into a library.

4. SCIENCE - A PROCESS APPROACH (SAPA): COMMISSION ON SCIENCE EDUCATION. 1962-1971. John R. Mayor, American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington, D.C. 20005.

---

[1]National Science Foundation, Course and Curriculum Improvement Projects, 1974, p. 6-8.

Digest. Science - A Process Approach is an elementary school science curriculum for use in kindergarten through grade 6. Topics covered in the exercises sample widely from the various fields of science. Mathematics topics are included, to be used when needed as preparation for other science activities. The program has a sequential pattern to provide a developmental progression of increasing competence in the processes of science.

5. ELEMENTARY SCHOOL SCIENCE PROJECT (ESSP). 1960-1969. J. Myron Atkin, Department of Elementary Education, and Stanley P. Wyatt, Jr., Department of Astronomy, University of Illinois, Urbana, Illinois 61801.

Digest. The project staff, made up of professional astronomers, science education specialists, and classroom teachers, identified and developed certain major conceptual themes in astronomy appropriate for upper elementary and junior high school students. Materials were revised on the basis of findings from extensive field tests and other evaluation activities. The final product is a series of six books, each accompanied by a teacher guide.

APPENDIX III

GENERAL GOALS OF A CAREER-SCIENCE CURRICULUM[1]

A. To instill in students an awareness of the broad range of careers available to them.

B. To integrate career information, and broaden the horizon of students as they learn to understand and use scientific processes in problem solving, and decision making.

C. To make obvious the value of science in student's career and educational planning.

D. To show students that there are respected vocations available for all ranges of intellectual and manual talent.

E. To provide student with better techniques to understand himself, his interests, talents and abilities, and how they fit his career potential.

F. To help develop an intrinsic motivation within the students for understanding science and perceiving the value of the science curriculum.

---

[1] Science Unit (Career Related), Minnesota State Department of Instruction, Vocational-Technical Division.

APPENDIX IV

NON-SCIENCE THEORY IN SCIENCE INSTRUCTION[1]

Throughout his recorded history, man has been vitally concerned to find out all that he can about his universe. He has explored it in many ways, raised questions about it, designed methods by which he could increase and organize his knowledge, and developed systems to aid him in understanding and explaining his own origin and nature and his place in the universe. Among these systems are philosophy, religions, folklore, the arts, and science.

Science is the system of knowing about the universe through data collected by observation and controlled experimentation. As data are collected, theories are advanced to explain and account for what has been observed. The true test of a theory valid in science is three fold: (1) its ability to explain what has been observed: (2) its ability to predict what has not yet been observed; and (3) its ability to be tested by further experimentation and to be modified as required by the acquisition of new data.

---

[1]Delaware State Department of Public Instruction, Equinox, A model for the natural science education curriculum for the second, third and fourth grades in the Delaware Schools, August 14, 1973.

APPENDIX V

READING FOR SCIENCE

One of the common excuses for not completing the expected work in science is that the children can't read. For this reason there are occasions when time which normally should be allotted to science instruction is used instead for reading. There are two possible solutions to this problem, neither to be considered alone:

1. Incorporate science material into the reading program;
2. Develop skills in reading science literature.

To incorporate science material into the reading program, the resources of the Instructional Materials Center become essential. A wide variety of interesting science-related books and magazines are on the market. If the reading needs of the science student are to be met, a well-stocked science section is a necessity in the IMC.

To develop skills in reading science literature there are several approaches that have proved to be effective. Since the science curriculum is activity-oriented, there are many examples of student involvement which will lead toward goal-attainment without relying on reading skills which may be missing or very weak. Science lends itself readily to the language experience approach used in the elementary school in which children dictate a story, or sequence science-related activities, and then read or

have this narrative read back to them. This practice helps to develop the key skills of comprehension in the elementary student. Skills that may be sharpened by this method include:

- the ability to draw conclusions;
- an understanding of the cause and effect relationship;
- the ability to detect sequences;
- competence in finding the facts;
- proficiency in getting the main idea.

At the middle school level the language experience approach can be used with the content of science by having the student dictate his own textbook. The information could be written on the board and then duplicated for class use.

A technique long proved effective in reading for meaning and understanding is the PQRST approach, a method attributed to the Air Force Academy:

Preview
Question
Read
Study
Test (formal testing or test yourself)

An explanation of these steps follows:

Preview

- Read the bold-face type
- Observe the pictures
- Read the captions
- Read the general questions at the end of the chapter
- If there is a glossary, study this.

Question

- Consider the items that are in bold face type and turn them into questions.

Read

- Keep the questions in mind, as well as the survey items, and then read the assignment.

Preview

- Answer the questions; these can be student or teacher originated.

Recite

- Communicate to someone in some way the information that has been gained. For the problem readers, this can be done orally. Others may wish to write their summaries. This communication may start with a structured question.